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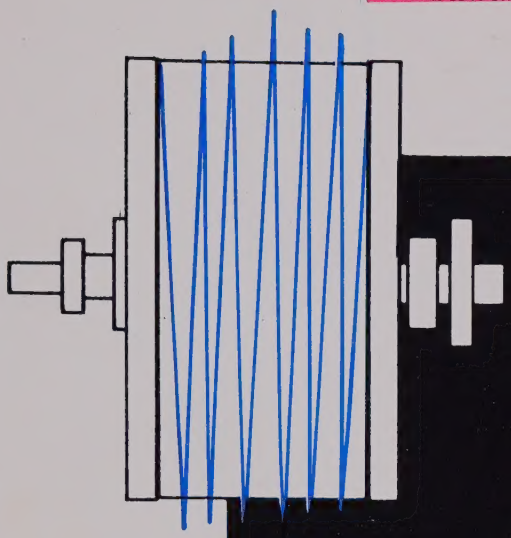
4636 4602C



DYNAMOMETER OPERATING INSTRUCTIONS

MAGTROL, INC.

MAGTROL, INC.
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Buffalo, New York 14224

MAGTROL DYNAMOMETER and ASSOCIATED EQUIPMENT

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SECTION 1 DYNAMOMETERS

1.1 General Description:

Dynamometers are absorption instruments designed to apply and indicate a motor load. This load is controllable and reads out directly in oz. in. or in other Engineering units. The following drawing illustrates a typical unit and part identification Refer to figure 1.

1.1.1 Operating Principle:

All Dynamometers are equipped with a Hysteresis Brake.

Essentially, when the rotor is forced to operate in a precisely defined magnetic field, it resists rotation dependent on the strength of this field. This basic fact, as applied to the Dynamometer, accomplishes two functions:

1. It applies a load to the motor, forcing it to work.

2. The suspended brake assembly, which is the reaction member, tries to rotate with the motor.

However, being weighted at the bottom, it is able to rotate only as far as the brake torque is able to lift the weight. If rotation of the input shaft is maintained, a condition of slip within the brake assembly exists. The value of this torque will be indicated on the integral torque dial. This torque is dependent on field strength which, in turn, is dependent upon applied current. Thus, the "Torque Adjust" control on the power supply, or other associated equipment, adjusts the applied current to the brake coil.

1.2 Set Up:

After all packing materials are removed and the Dynamometer carriage and shaft are free, the unit should be leveled where it is intended to operate. A leveling bubble is provided on the base plate and should be used to level front to rear. Use the hair line indicator for leveling sideways so that the torque dial reads "0".

1.2.1 Motor Attachment:

Since electric motors assume a variety of sizes and shapes it is practical only to cover undesirable effects of poor coupling techniques. Naturally, whatever torque is indicated on the Dynamometer is also present on the motor itself. Therefore, torsionally secure mounting is essential.

1.2.2 Shaft Alignment and Coupling Considerations:

Shaft alignment and coupling considerations are important from a stand point of vibration, read out accuracy, and bearing life. Since perfect shaft alignment is difficult, a flexible coupling is essential in most applications. It is desirable to use one which can tolerate both a modest amount of straight mis-alignment, as well as radial eccentricity. There are a wide variety of couplings available, and many are satisfactory for this service. All Dynamometer input shafts are in standard inch sizes. Refer to the following table.

DYNAMOMETER SHAFTS		
DYN. MODEL	FRACTIONAL	DECIMAL
HD - 106	1/8"	.1245/.1250
HD - 400	1/4"	.2495/.2500
HD - 500	3/8"	.3745/.3750
HD - 600	1/2"	.4995/.5000
HD - 700	1/2"	.4995/.5000
HD - 705	1/2"	.4995/.5000
HD - 800	1"	.9995/.1000
HD - 805	1"	.9995/.1000

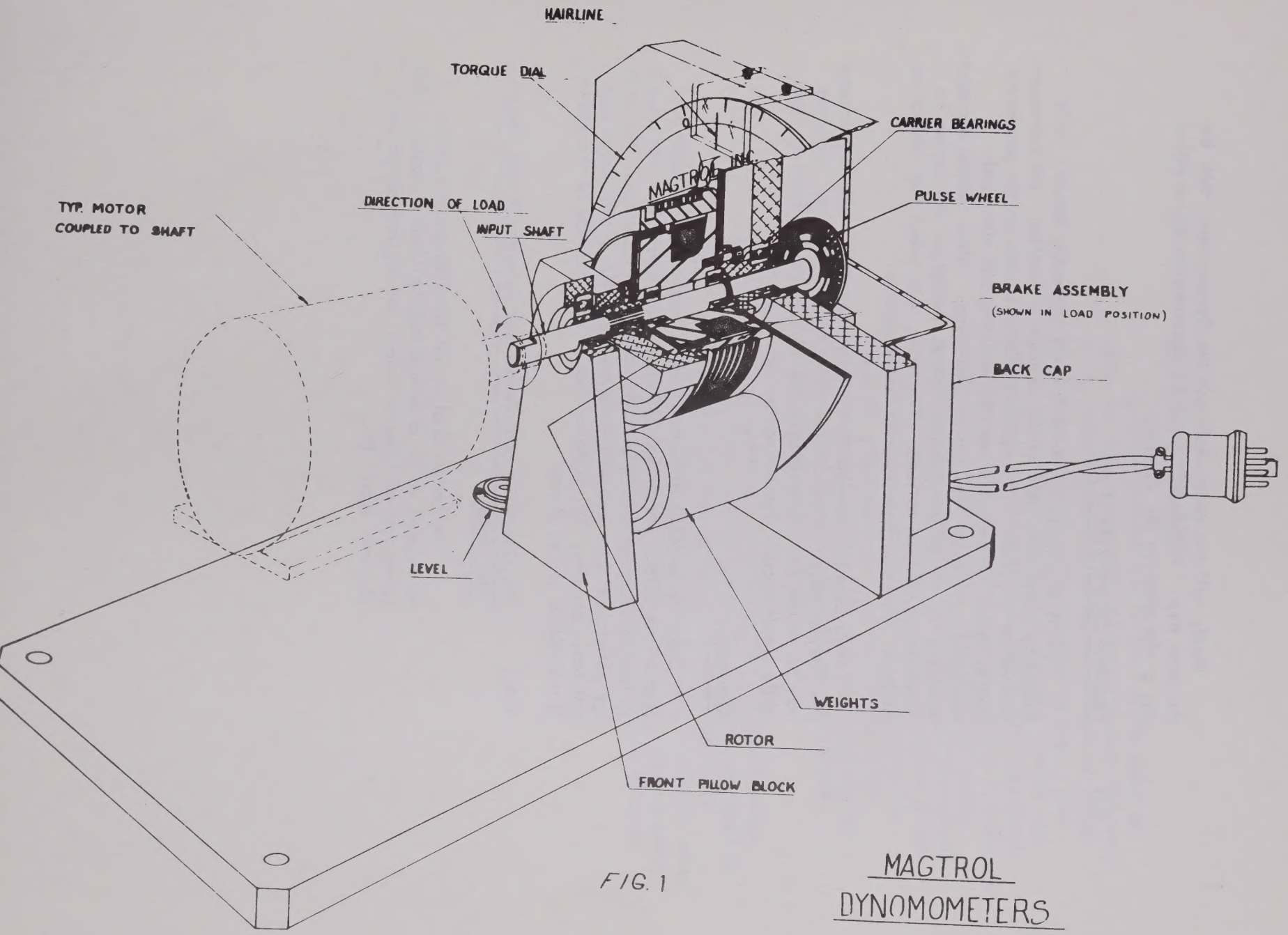


FIG. 1

MAGTROL
DYNOMOMETERS

DRWG.* SK-1005

Rarely will the motor shaft and the Dynamometer shaft be the same size. Therefore, it may be necessary to adjust either one or the other to the coupling.

1.3 Magnetic Salient Pole Effect:

This is a condition prevalent to all Hysteresis Brakes. It is caused by imposing a field in the absence of rotation and subsequent removal of the field. This action establishes poles on the permanent magnet rotor. These poles react by resisting and alternately supporting rotation as they pass a tooth form. When inertia is present, however, the action and reaction cancel themselves and impose no resistance to rotation as such. Therefore, with speed they reflect no minimum value and have essentially disappeared.

Their complete removal is a simple procedure. Do not decrease the "Torque Adjust" from a given point without rotation. Rotation may be in the form of oscillating the input back and forth by hand while simultaneously decreasing the torque control.

1.4 Accuracy:

Since no springs, dampers, or other mechanical linkages are used in the Torque Indicating System of these units, it is not subject to long or short range drift of basic calibration accuracy. The units are calibrated to an accuracy of better than 1% on all ranges and this basic accuracy will never be lost. The accuracy of the system is a function of two things.

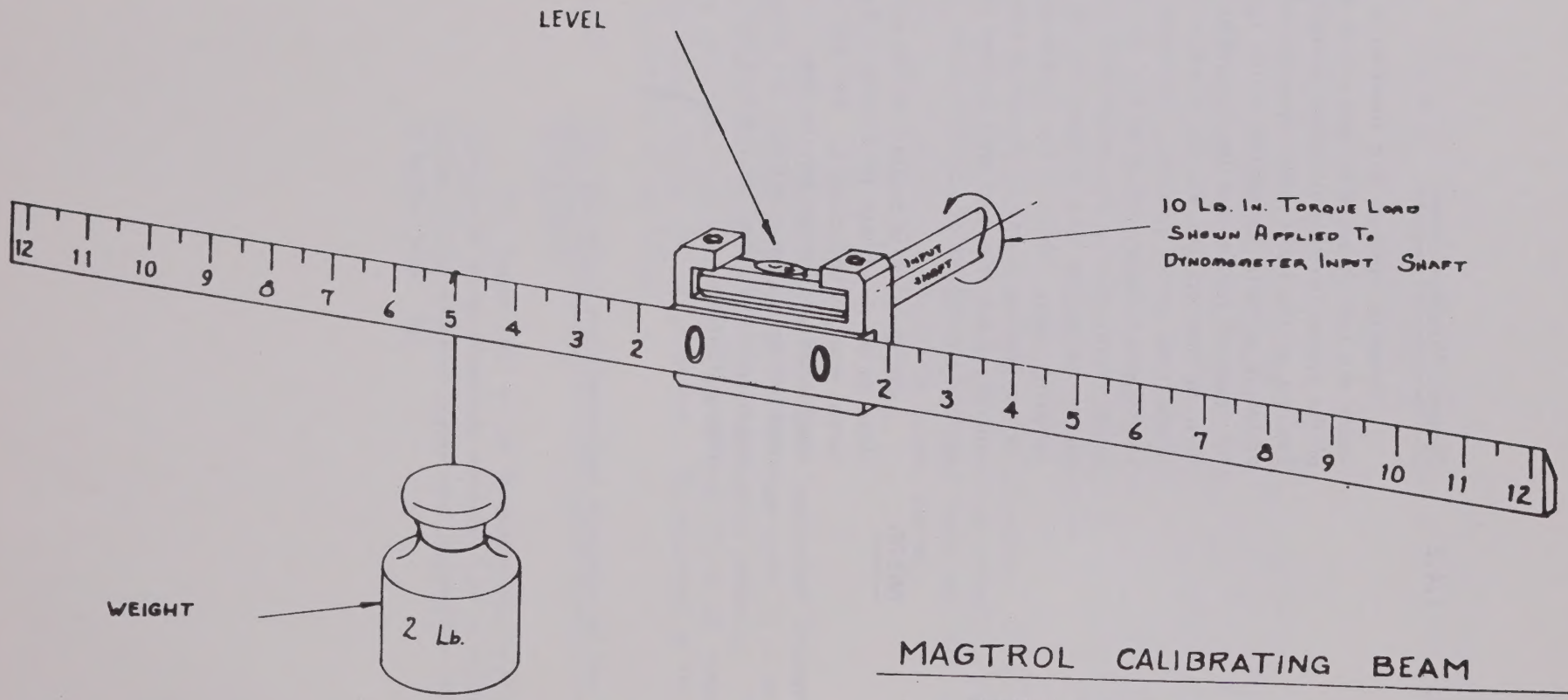
1.4.1 The Geometric and Mechanical Accuracy of the Torque Dial Layout:

The Torque Dial on all Dynamometers is photo reproduced on an aluminum material from a master. This system has an inherent layout and registration accuracy of better than .1%.

1.4.2 Dynamic Windage Error:

Dynamic windage is a function of the speed at which the unit is operated and occurs because the rotor of the Brake Assembly generates currents of air which impinge on the brake stator reaction member. This action is primarily tangential to the rotor surface and the resultant torque reaction is against the brake stator in a manner that the viscous effect is read as a component of the total torque reading. However, due to some centrifugal pumping action of the rotor and the toothed outer construction of the brake stator, a portion of the air moved by the rotor is dissipated as pumping loss requiring torque which is not compensated in the Torque Reading System. This error may generally be ignored, since it occurs only at very high speeds; typically in excess of 25,000 R.P.M.

NOTE: No damping is applied to the carriage assembly, since to do so without introducing a finite component to torque error is unavoidable. For this reason some mechanical oscillation may be observed occasionally when establishing a torque setting. An operator soon acquires experience and "feel" of the unit and learns to damp this oscillation.


LEVEL
10 Lb. In. Torque Load
Shown Applied To
Dynamometer Input Shaft
INPUT SHAFT
12 11 10 9 8 7 6 5 4 3 2 0 0 2 3 4 5 6 7 8 9 10 11 12
WEIGHT
2 Lb.

MAGTROL CALIBRATING BEAM

CONSULT FACTORY

SK-1006

Fig 4

1.5 Calibration of the Counterweight:

All torque ranges are calibrated to a full scale accuracy of better than 1%. The calibration of any unit may be checked.

1.5.1 The most accurate method of calibrating a Dynamometer is with a beam and dead weight. To accomplish this it is necessary to have a balanced and structurally rigid arm, which will precisely fit the shaft, and be calibrated in inches.

This part is available from Magtrol, Inc. upon quotation. Specify Dynamometer size or serial number.

1.5.2 Utilize good quality calibrated weights such as "Ohaus Scale Corporation, Union, New Jersey". A precise distance-weight relationship must be set up. Refer to figure 4. The applied torque is = force x distance.

Example: 2 pounds at a distance of 5 inches is equal to a torque of 2 lb. x 5 in., or 10 lb. in. To convert to ounce inches, 16 ounces to the pound or 10 x 16 equals 160 oz. in.

NOTE: Beam must be exactly horizontal with load attached and the dynamometer balanced.

1.6 Power Dissipation:

All Magtrol Dynamometers are absorption types. There are ultimate limits to which the equipment may safely absorb power in the form of torque and speed.

Due to the close proximity of the rotor to the pole and case assembly, heat transference into these members is rapid and little thermal gradient exists.

The limiting factor for temperature rise is the Dynamometer coil and bearings. The maximum operating temperature has been rated at 100°C in consideration of bearing lubricants.

This upper limit may occur by either low power input for a long period of time, or high power for a short period of time.

The following are a series of Curves of Watts input Vs. Time. From a knowledge of torque and speed, or H.P., watts may be readily determined by the following formulas:

$$1 \text{ H.P.} = 746 \text{ Watts}$$

or in the case of torque and speed

$$\text{H. P.} = \frac{Q \times N}{5252}$$

Where Q = lb. ft.
N = R.P.M.

or a less accurate, (.8%) error, but more simple formula:

$$\text{H.P.} = Q \times N \times 10^{-6}$$

Where Q = oz. in.
N = R.P.M.

Example: HD 700 Dynamometer and
1/4 H.P. Split Phase Motor

This motor may develop 325 oz. in. at 1710 R.P.M. just before stall. Therefore:

$$\text{H.P.} = 325 \times 1710 \times 10^{-6}$$

.55 H.P.

$$\text{Watts} = .55 \times 746 = 410$$

Referring to the curve for the HD 700, we see that the instrument will absorb 410 watts for 16 minutes.

The HD 800 and HD 805 have an air cooling system which greatly increases the power dissipating capability. Refer to the Installation Drawing supplied with this unit for air capacity requirements. The power absorption curves on these units are shown with and without air cooling.

There is no HD 106 Power Dissipation Data since the maximum torque is only 2 oz. in., Speed in excess of rating would be necessary to realize maximum recommended temperature rise.

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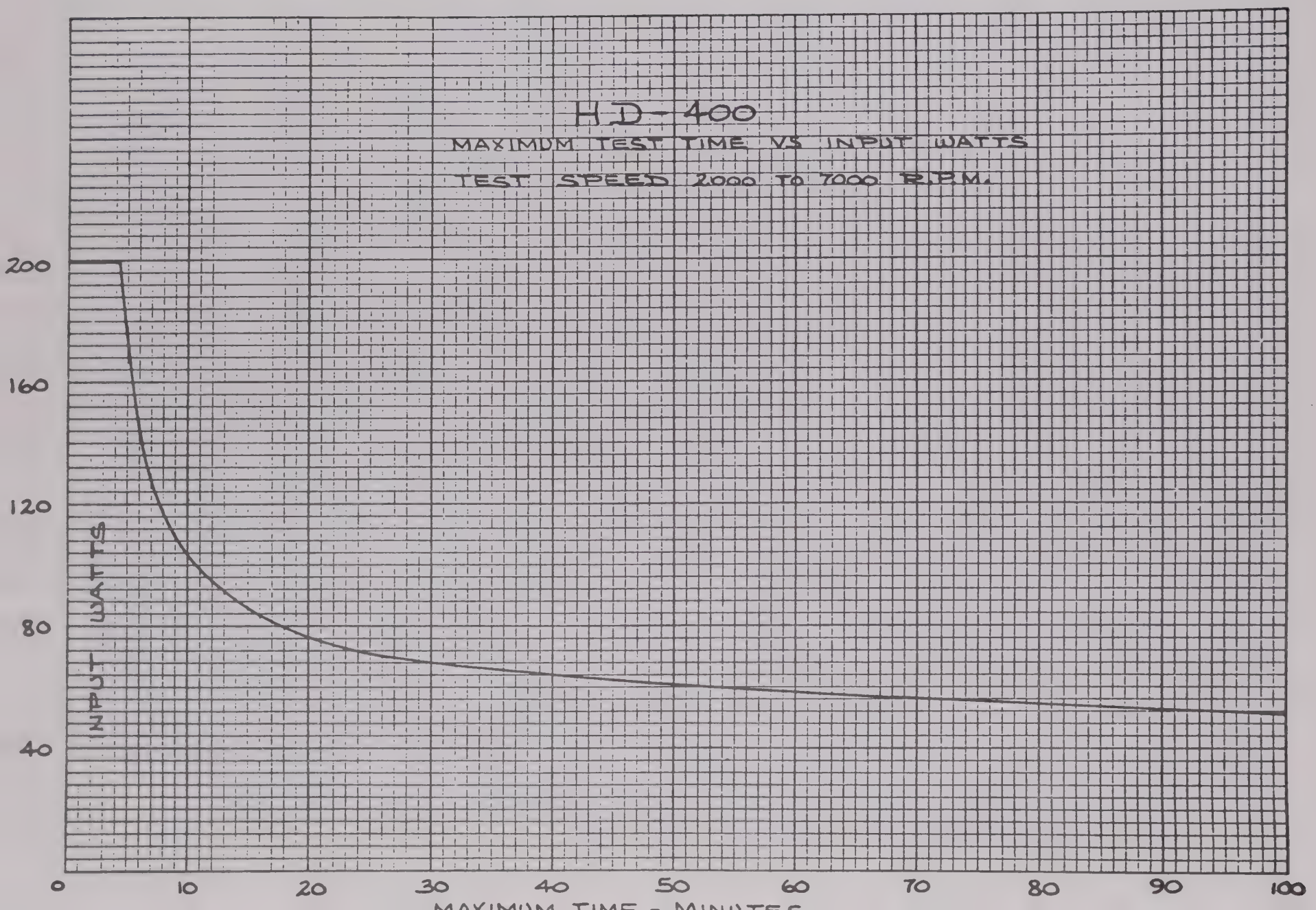

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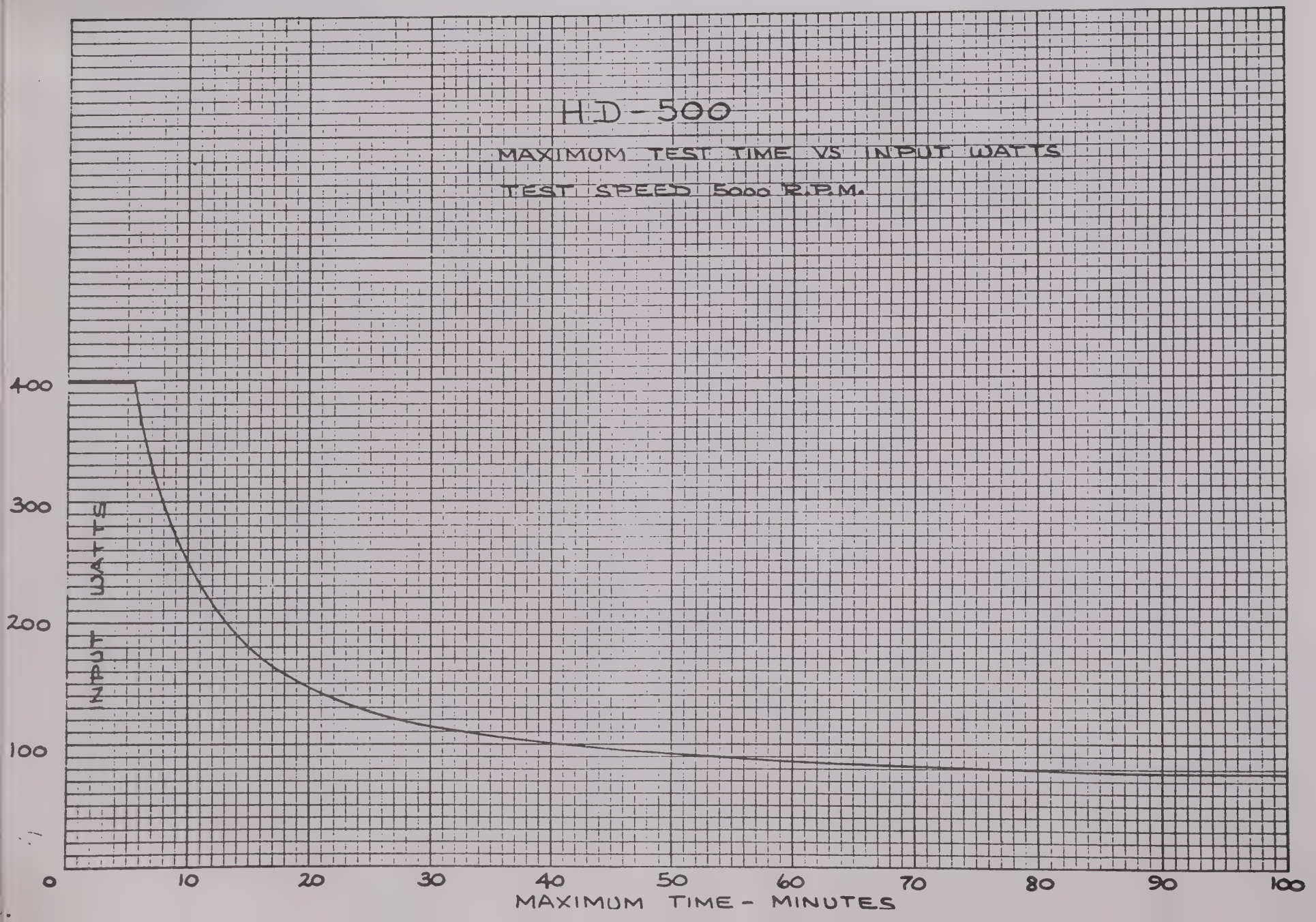

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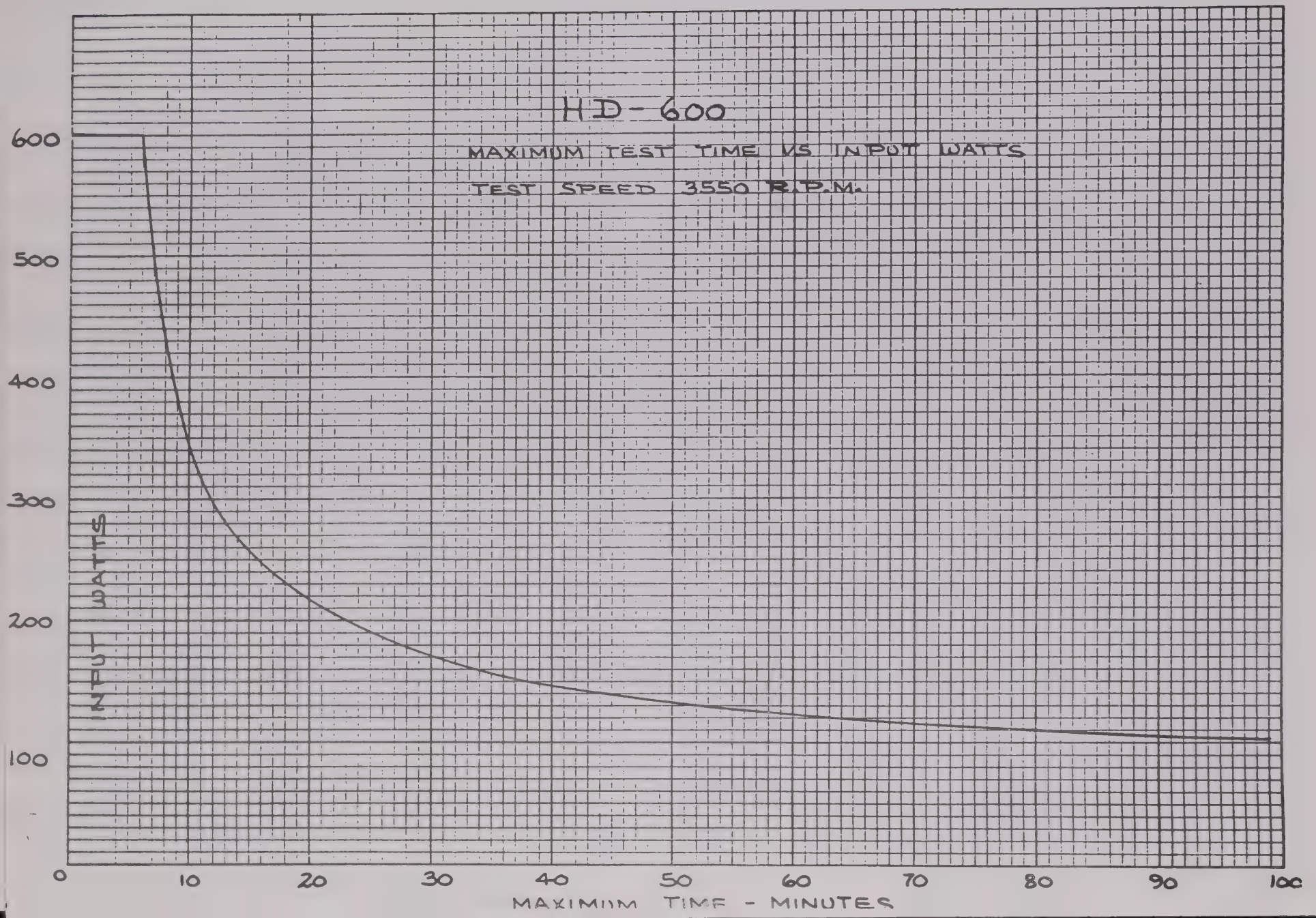

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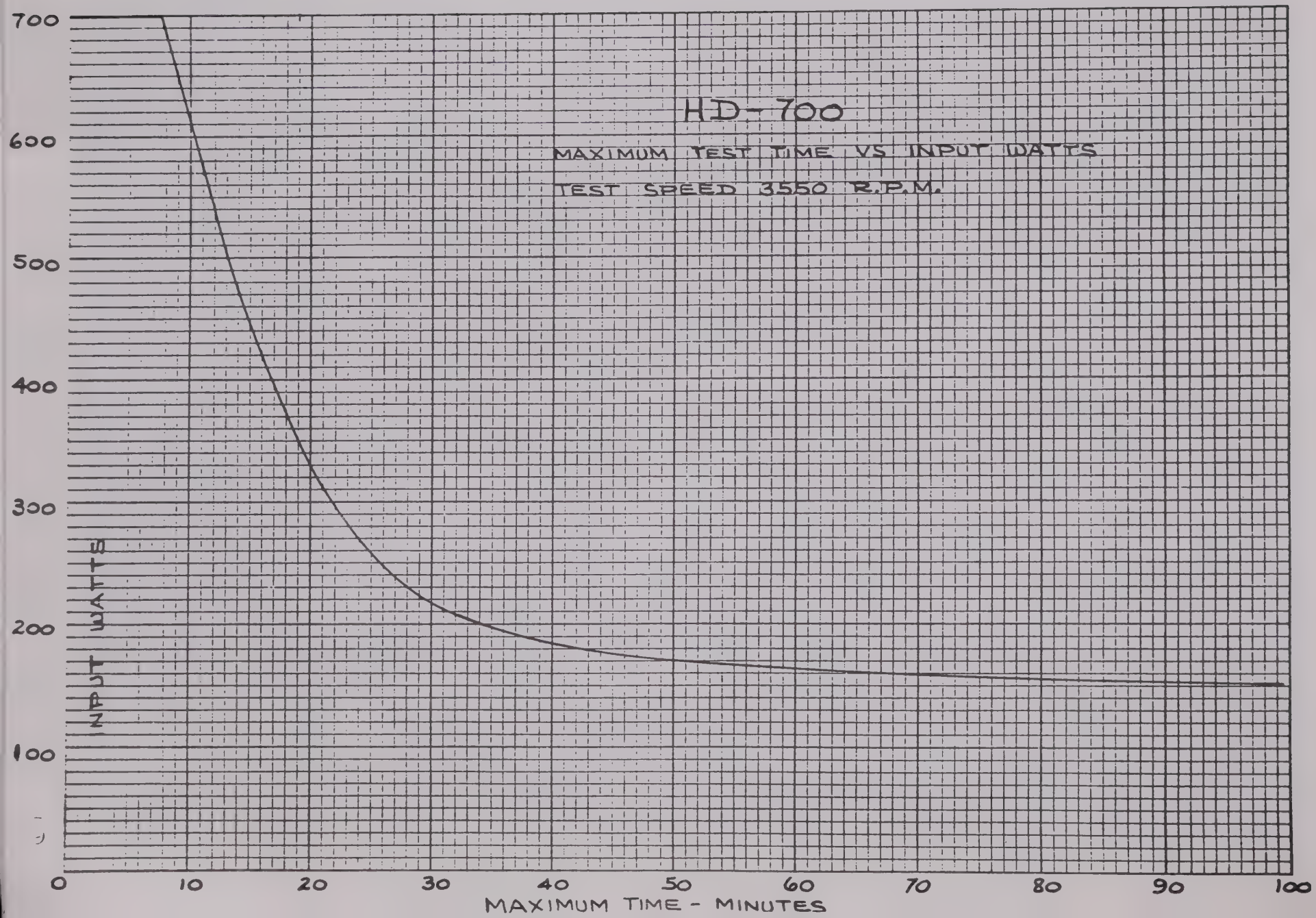

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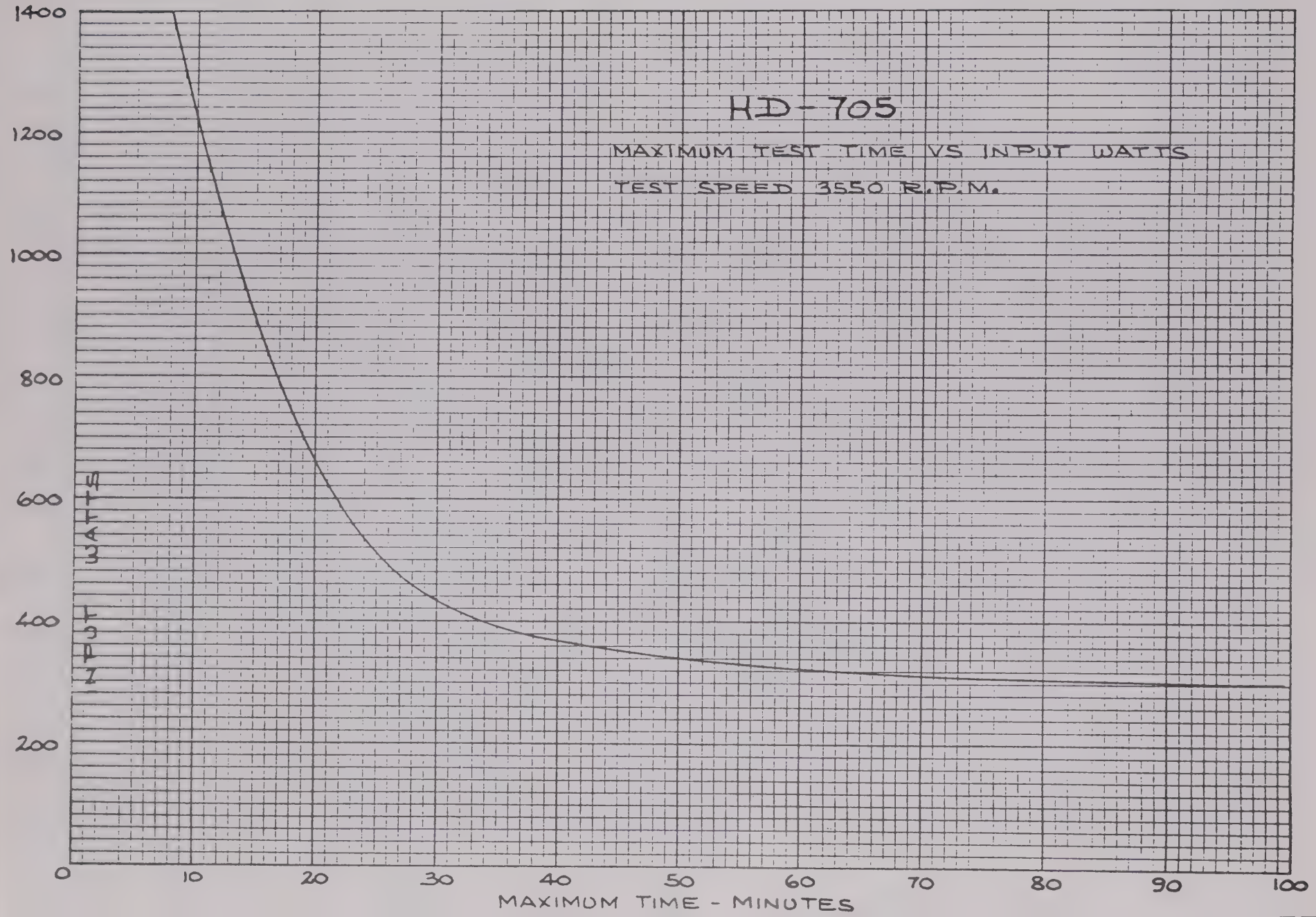

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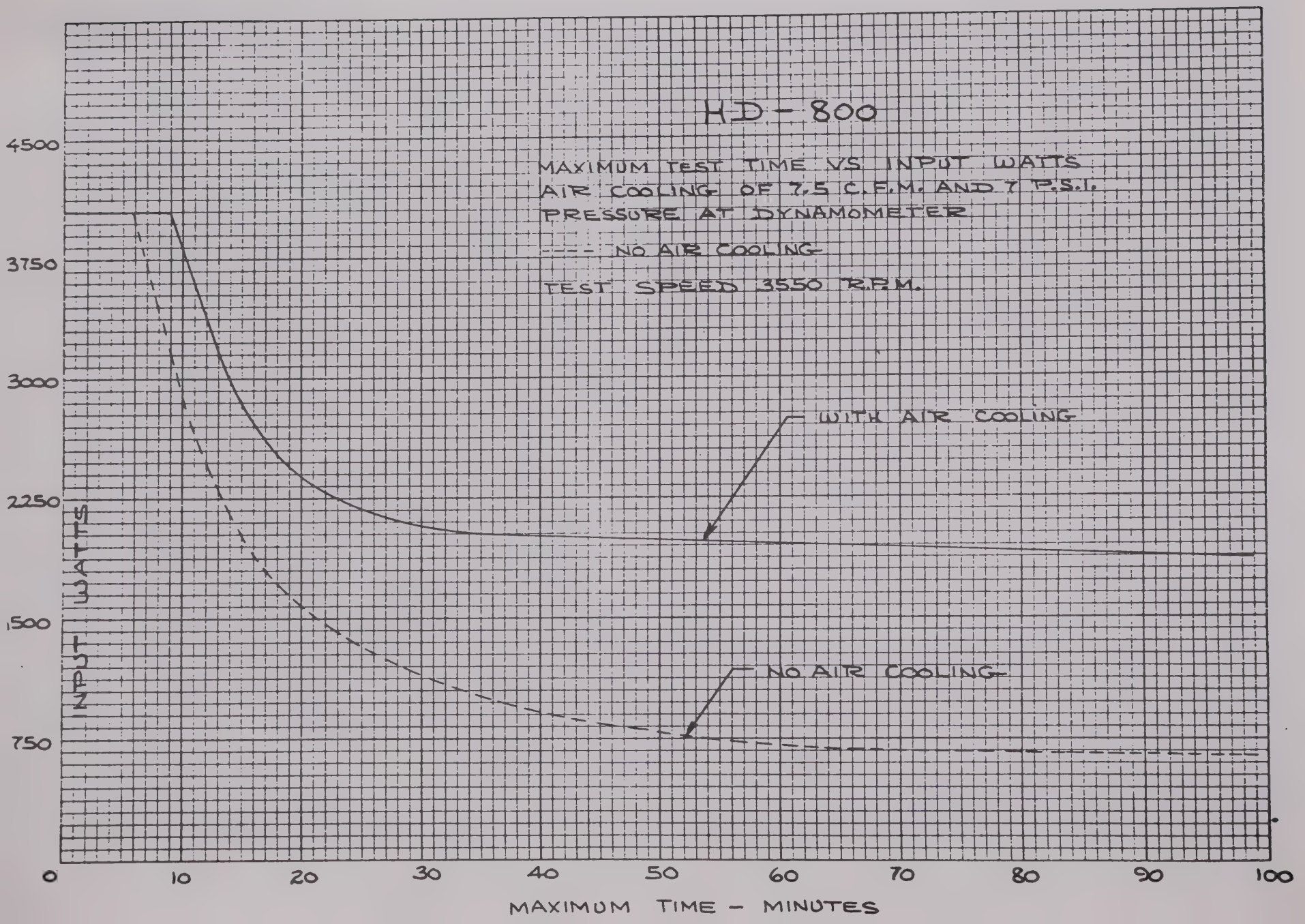

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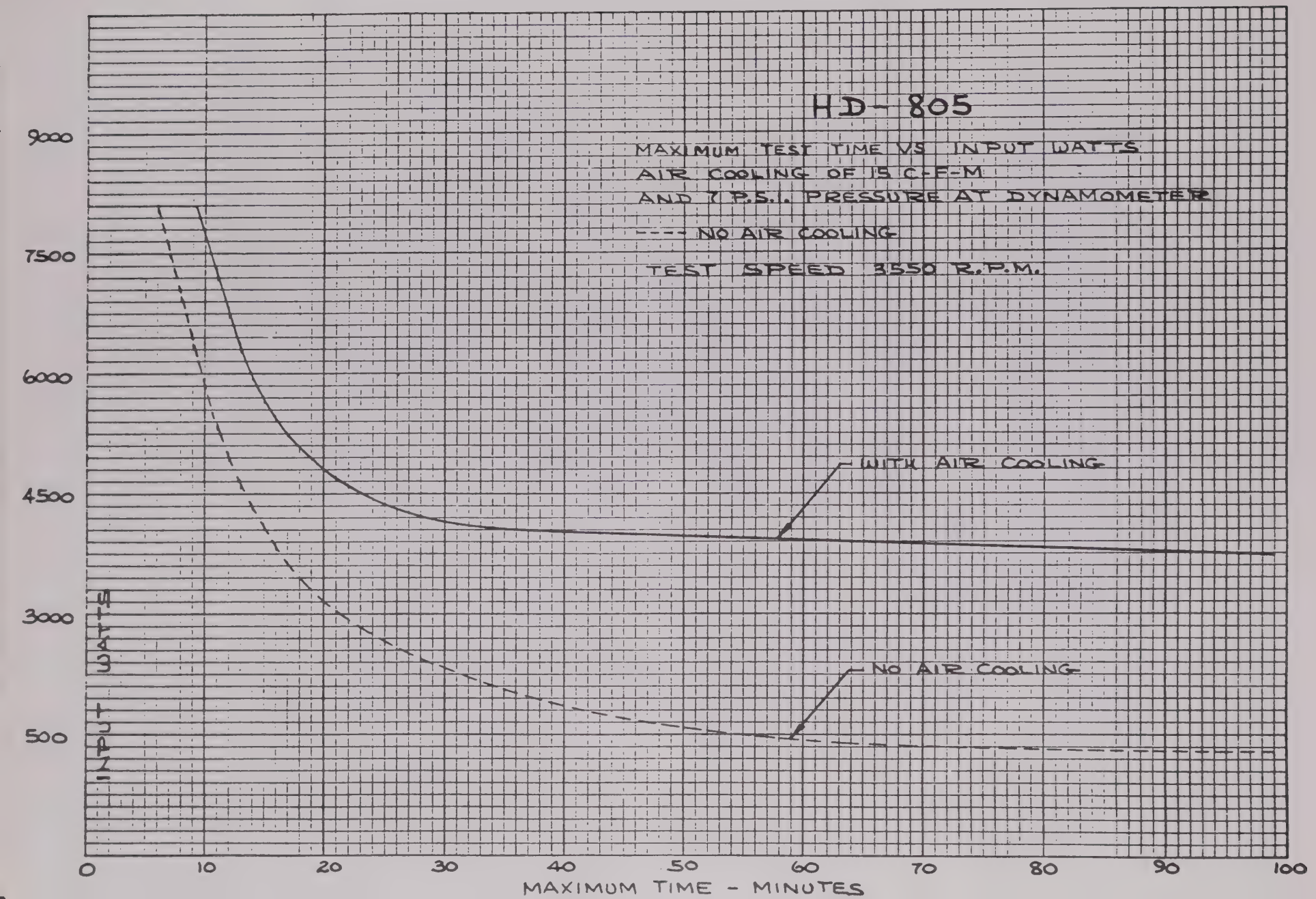


1.7 Maximum Recommended Operating Speed:

The maximum no load speed is dependent on the degree of rotor balance attained on each individual Dynamometer and the equivalent air gap. Due to normal manufacturing tolerances each instrument must be tested to establish the maximum safe operating speed. This speed is recorded on a tag with each unit. It contains an automatic 40% safety factor.

1.8 Maintenance:

1.8.1 Lubrication: No lubrication is required since the only rotating friction components are sealed, permanently lubricated, ball bearings.

1.8.2 Cleaning: Do not use cleaning solvents. A moist cloth is usually adequate.

1.8.3 Dis-assembly: All models except HD 705 and HD 805.

1. Remove the rear cap.
2. Remove the light gate disc.
3. Unsolder the two brake lead wires terminating at lower edge of the phenolic block and remove block and cable assembly.
4. Remove the hairline at the top of the upright plate.
5. Remove the two (2) screws holding the front pillow block.
   NOTE: On the HD 800 or HD 805 models the rear pillow blocks are doweled to the base plate. Proceed as above, except remove bolts of both front and rear pillow blocks and lift entire brake assembly straight up from the base plate.
6. The entire brake assembly may now be withdrawn from the front plate.
7. Remove both carrier bearings and clean or replace.
8. Remove the torque dial.
9. Remove the weight assembly.
10. Remove the rear bearing cap and front yoke.
11. The shaft and rotor assembly may now be removed by first removing the shaft snap ring at the rear of the brake assembly.

12. If the shaft has been bent, or if the shaft is otherwise tight, it will be necessary to press the shaft out of the brake assembly. Support the brake assembly on the outer flanges of the magnetic case and press the shaft and rotor out. DO NOT PRESS AGAINST THE ROTOR.

This is as far as the Dynamometer should be disassembled without special jigs and fixtures.

Re-Assembly: The reverse procedure outlined above should be followed, with the additional inspections and adjustments as follows:

1. With an air hose clean the gap of the Dynamometer brake assembly to free it of any accumulated dust and metal chips.
2. If checking equipment is available, the shaft and rotor assembly should be checked for run-out. With the shaft running true the maximum allowable run-out on the outside diameter of the rotor should be less than .002.
3. When assembling the shaft and rotor assembly to the brake assembly, press the shaft into the rotor so that the axial play of the shaft with the snap ring in place is from .002" to .004".
4. When feeding the wires through the hole in the rear plate, leave a large loop for the wires to flex. Be sure there are no corners or sharp edges on which the wires can catch or chafe.
5. Large clearance holes are provided in the Dynamometer base plate for holding the front pillow block. Adjust the position of the front pillow block until the brake assembly swings free and will return to zero using the smallest torque counterweight. The entire assembly should have .030 to .040 axial play.

MODELS HD - 705 AND HD - 805

Both of these units are built using two Hysteresis Brakes, back-to-back, on a single shaft.

Dis-Assembly:

1 - 9 Follow steps 1 - 9 in Section 1.8.3

10. Remove both yokes from the brake assembly.
11. The rear rotor is retained by two 10-32 dog set screws. Loosen and slide the rotor off the shaft.
12. The front rotor and shaft assembly may now be removed. If it is necessary to press the shaft, do not rest the brake assembly on the rotor.
13. The front and rear brake stators may now be separated by removing the 3 - 10-32 cap screws. When separating be extremely careful not to cut or chafe the lead wires passing through the rear stator assembly.

This is as far as the unit should be dis-assembled. For further work the unit should be returned to the factory or worked on only on further advice from the factory. Special jigs and fixtures are required.

Re-Assembly:

Generally, the reverse procedure should be followed, making sure of the mechanical alignment of the wire pockets, lead wire arrangement, etc.

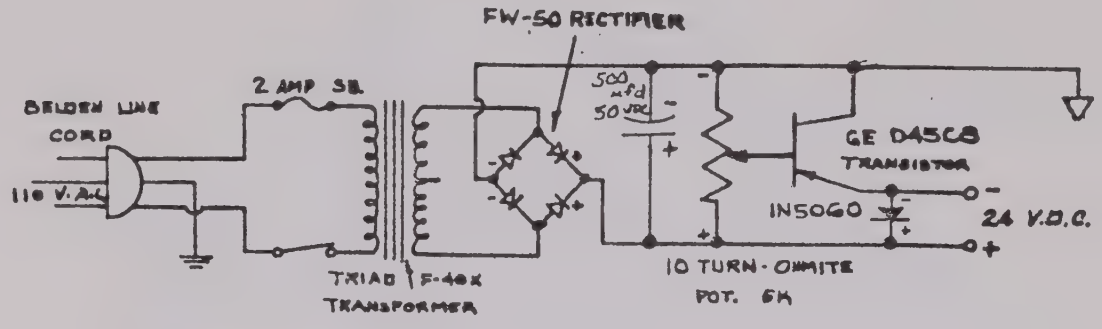
SECTION 2 POWER SUPPLY MODEL 4636

2.1 General Description:

The Dynamometer Brake requires an adjustable current for torque control. This current must be D.C., however, due to the large inductance of the brake coil, it need not be pure D.C. The electronic components are housed in an aluminum casting to provide a rugged and durable unit. The unit requires a power source of 117 Volts 60 Cycle Single Phase.

2.2 Circuit Description:

Refer to drawing No. 4636. The Dynamometer coil requires a voltage of 0 to 24 V.D.C. This is accomplished by transformer T_1, which reduces the line voltage to 24 V.A.C. D_1 is a silicon rectifier which convert the 24 V.A.C. to 24 Volts D.C. Potentionmeter P_1 permits a voltage source to the "Base" element of Transistor Q_1 to be adjustable from 0 to 24 V.D.C. relative to common plus side. The "collector" of Q_1 is common to the negative source.. Therefore, the "emitter" will follow the adjustable voltage with current amplification. The power output is adequate for all Dynamometers. This circuit is protected against short circuit or component failure by a 1 ampere "slow blow" fuse. This fuse is located in the box and is accessible by removing the bottom cover plate.



SCHEMATIC

QTY	IDENT	DESCRIPTION	MAG. P.N.
1	-	TOP PLATE BEZEL	41-0132
1	LC1	LINE CORD	88-M-001
1	C1	ELECT. CAP., 500 MFD 50VDC	70-E-013
1	R1	BRIDGE RECT. FW50	71-B-002
1	R2	G.E. IN5060	71-S-002
1	F	FUSE 1A SB.	72-F-002
1	P1	5K 10T POTENTIOMETER	77-M-014
1	SW	SWITCH SPST.	84-T-002
1	S1	RECEPTICAL CN. 302 CCT	85-F-006
1	Q1	TRANSISTOR GE. D45C8	86-P-003
1	T1	TRANSFORMER F-40-X	87-V-004

MAGTROL, INC.

MODEL 4636 POWER SUPPLY

SECTION 4 TACHOMETER PICK-UP

4.1 General Description:

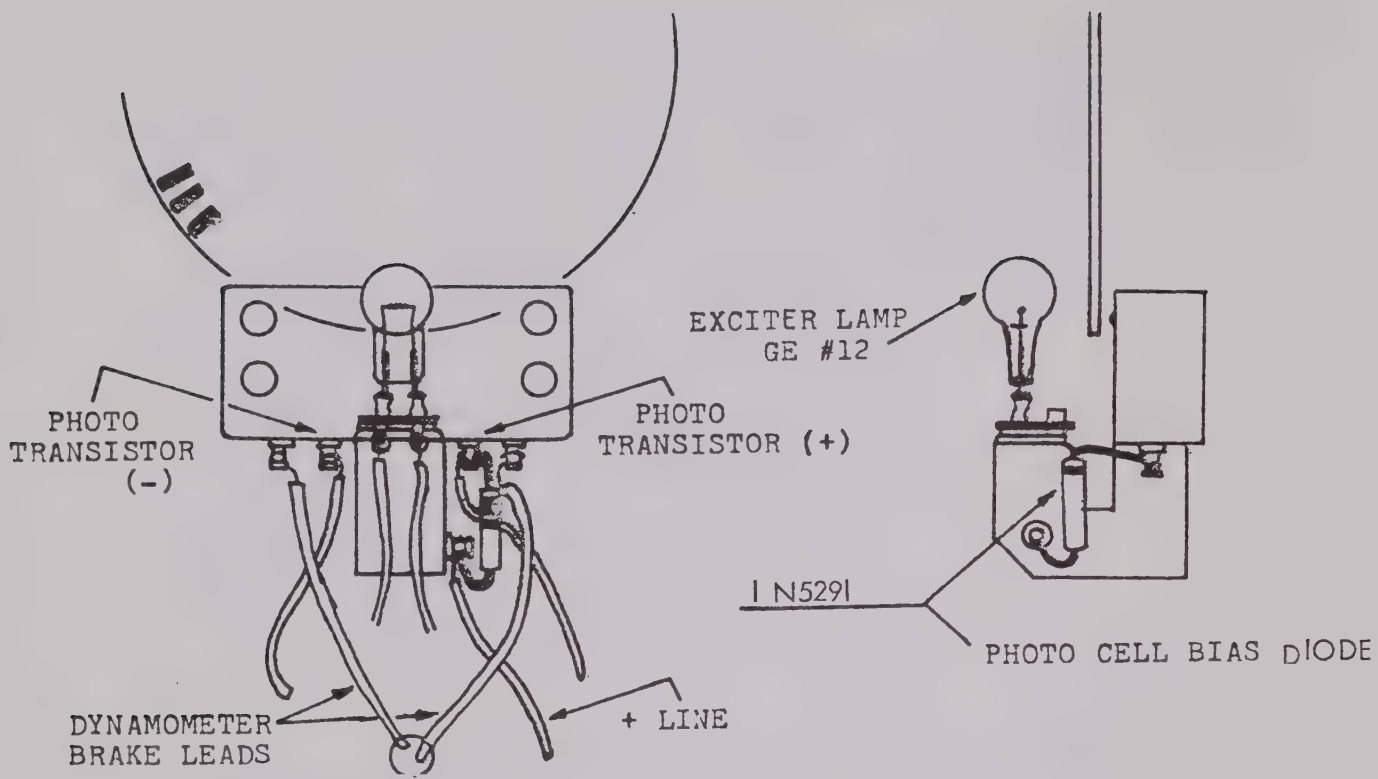
4.1.1 Refer to figure 5. The principle of operation is the resolution of increments of a revolution by interrupting light falling on a photo-cell. This interruption is obtained from a segmented plastic disc. The bars form 4 tracks of 60 bits/revolution, 30 bits/revolution, 6 bits/revolution and 3 bits/revolution. As the light to the photo-cell is modulated, the cell changes resistance. The cell is biased by approximately 100 micro-amperes which provides a voltage modulation across the cell proportional to the change in resistance. The wave form output is approximately square at low frequencies which modifies to a saw-tooth wave form at higher frequencies. The upper range is approximately 30 K.C.

4.1.2 Exciter Lamp:

The exciter lamp is a G.E. No. 12 long life bulb, requiring a D.C. voltage of 5 to 5.5 volts, with a maximum ripple content of 100 millivolts.

4.2 Frequency Adjustment:

Referring to figure 5, any one of the four tracks are available by removing the 6-32 Socket Head Cap Screws and moving the block to the track required. It is necessary, when making this conversion, to remove the lamp and pulse wheel in order to get at the mounting screws.



TACHOMETER GENERATOR
PART NO. 7116

FIGURE 5.

5. MODEL 4602C DIGITAL TACHOMETER

5.1 Specifications:

Power Input:	10 Watts Maximum 117 VAC 60 HZ 230 VAC 50* or 60 HZ
Speed Range:	Above 35,000 R.P.M. (refer to dynamometer speed rating)
Display:	.55 Character, flat plane gas discharge. Continuous indicating with zero blanking.
Accuracy:	Line frequency, typically .01% $\pm$ 1 count.

*For 50 Hz operation the dynamometer must be equipped with a 50 bit/rev. pulse disc; Magtrol part number 89-D-002.

5.2 Incoming Inspection:

Upon removal of the instrument from the shipping carton, inspect the unit for obvious damage. Retain the packing material until an operational check has been performed. In the event of damage or shipping abuse, the carrier should be notified for inspection of the equipment and the packing material.

5.3 Set Up and Operational Check:

-Plug the unit into a suitable line source.

-For the protection of operating personnel and in compliance with the National Electrical Manufacturers Association (NEMA) recommendations, this instrument is equipped with a three-conductor power cable. When used with a suitable outlet, earth grounding of the cabinet is obtained.

-Connect the dynamometer 6 pin plug into the socket provided on the rear panel. If the 4602C is used with other Magtrol special purpose power supplies (4609 or 4634 or 4603), a cord set is provided to interconnect the units.

-Turn the unit on.

-Spin the dynamometer shaft by hand and observe if a count is displayed. If a count is displayed, then it can be assumed that the instrument is operating properly.

-If the unit is inoperative, assume shipping damage and contact "Dynamometer Customer Service" at the factory for instructions.

5.4 Operating Characteristics:

The 4602C Digital Tachometer is basically an "events" counter which, when equipped with a time base, becomes an events per unit of time indicator, or frequency counter.

Since a period of time is necessary to accumulate a count, the read-out is the average speed over the count period of .5 seconds for 60 Hz and .6 seconds for 50 Hz.

All Magtrol digital dynamometers are equipped with an optical shaft encoder for speed transducing. The explanation of this assembly is covered by paragraph 2.1.2.

Two types of encoder discs are used. For 60 Hz operation, a 60 bit per revolution disc is used, Magtrol P/N 89-D-001. For 50 Hz service, a 50 bit per revolution disc is necessary, P/N 89-D-002.

On the rear panel of the 4602C Tachometer or the 4605 Torque-Speed indicator, a frequency output is provided on a miniature phone jack. This frequency is proportional to speed at a rate of either 50 or 60 pulses per revolution. The output is TTL level signal in series with 4.7K resistor.

5.4.1 Noise and Erratic Performance·

High speed integrated circuits are susceptible to high frequency transient noise. Some commutated AC-DC motors product high current "spikes" which transmit as R.F. noise. This combination can, under the right conditions, cause an occasional reading error.

The noise may be induced by either or both the line power or R.F. pickup. The solution is isolation of the line or shielding from the R.F. noise, or both.

Line Isolation:

Generally, noise is more easily eliminated at the source. If this is not practical, a small electrostatically-shielded line isolation transformer on the 4602C will usually suffice. A power rating of 25 watts is adequate.

Shielding:

A grounded metal barrier may be necessary between the motor and the readout equipment in extreme situations. Separation and shielding of the input lines to the tachometer and input lines to the motor may be necessary.

5.4.2 Circuit Description:

5.4.2.1 Power Supply:

All power to the unit is obtained through a transformer P.N. 87-V-012. This transformer has a "split primary" which series connected, sets up the transformer for 230 VAC 50 or 60 Hz; parallel connected is 115 VAC.

Two levels of power are required:

1. 5 Volt D.C. logic level, operating at approximately 0.8 amps.
2. 200 Volt D.C. source of power for the gas discharge displays.

Referring to the Schematic diagram 78-B-004-005. The 5 volt logic level may be checked at any approximate point identified as Vcc. The 200 VDC level exists only on the upright PC Board containing the readout indicators.

5.4.2.2 Time Base:

The time base sections used a signal from the transformer secondary to trigger a N74121 one shot, after suitable diode steering and current limiting. The output of the N74121 is divided by 3 using the N7473 Dual JK. This division process yields a pulse of approximately 80 ms. duration every .5 seconds when counting 60 Hz.

This basic pulse is broken up into two discrete intervals. One interval simultaneously applies an inhibit command to the counter input (1/3 N7411), and a print command, which opens the storage registers such that the decoder drivers look at the counter BCD outputs. On the second interval the 7475 quad latches close, maintaining the information on the decode driver. The counters are reset to zero in preparation for another division process, or count period.

5.4.2.3 Counter Section:

Fifteen elements plus the digital readout devices comprise the count down section. Each N7490 is a basic 4 bit counter producing a BCD output for each 10 input bits. The N7475 elements are quad latches maintaining a continuous readout while a new count takes place. The BCD information is decoded by the DD700 decode drivers, which accept 4 bits of BCD and decode to operate seven segment display readout devices.

5.4.2.4 Counter Input:

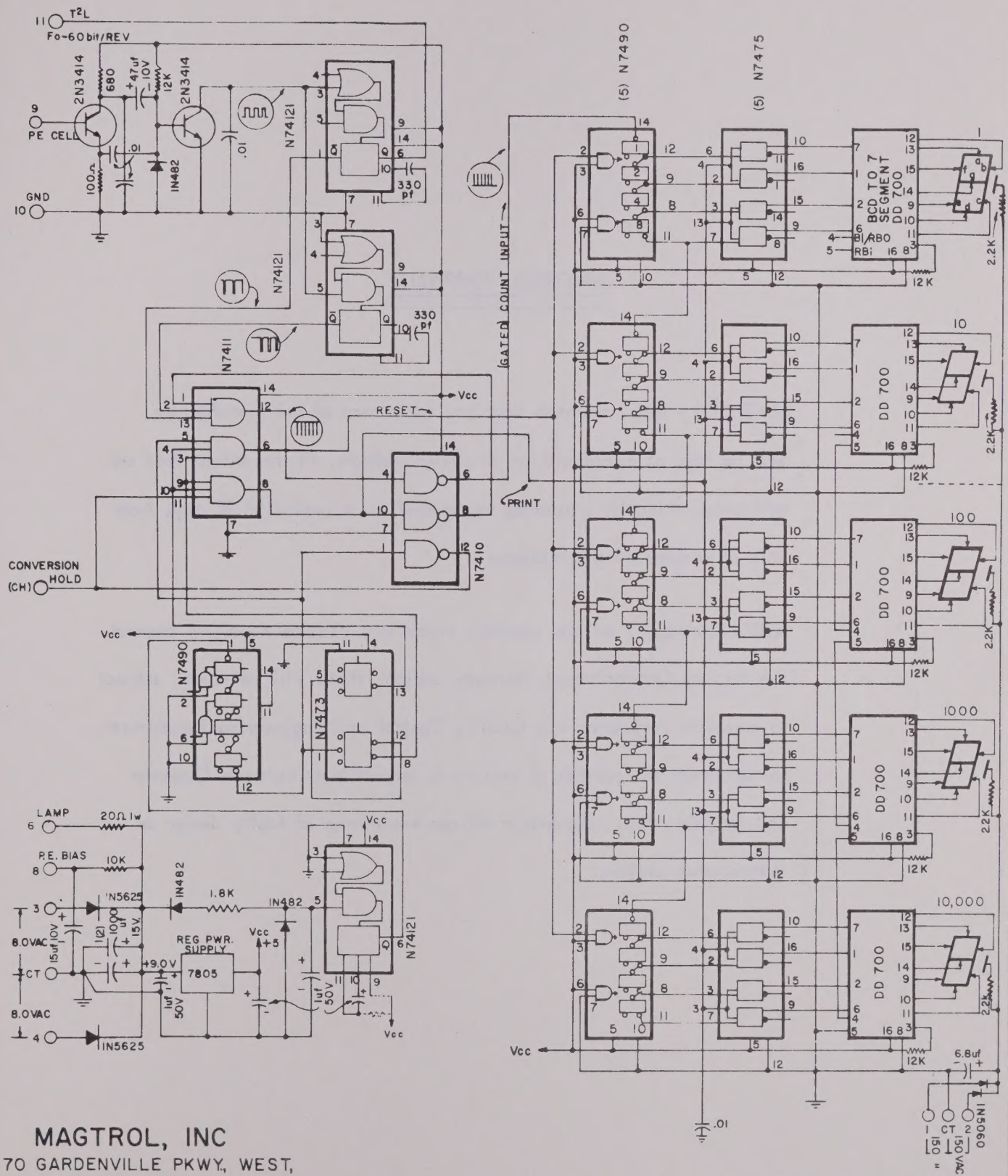
Raw frequency is received from the photo cell located in the dynamometer. The signal is amplified by a 2N3414 transistor, AC coupled to a second 2N3414 transistor. Two N74121 (Schmitt trigger, one shot multivibrators), are triggered by the second 2N3414. One, one shot is triggered by a positive transition. The other N74121 by a negative transition of the input.

The outputs are coupled by a "and" function gate to produce a timed pulse, twice the frequency input. The third input of this gate receives the count inhibit from the time base. The "and" output triggers the least significant digit of the counter section.

5.5 Maintenance:

The tachometer unit does not incorporate any moving parts, nor is there any internal calibration or other adjustments to perform. Therefore, there are no periodic maintenance requirements.

When cleaning the unit, or the Polaroid mask, use a damp cloth, but do not use any solvents that might attack either the paint surfaces or the plastic mask.



MAGTROL, INC
70 GARDENVILLE PKWY, WEST,
BUFFALO, NEW YORK.

SCHEMATIC- 5 DIGIT TACHOMETER
P.C. BDS. NO. 78-B-004, 005.

MAGTROL WARRANTY

MAGTROL, INC. warrants that any equipment of our manufacture will be free of manufacturing or design defects, to the extent that we will unconditionally guarantee equipment for a period of 90 days from date of receipt by the customer.

ADDITIONALLY, on any repairs, which may become necessary beyond the 90 Day Unconditional Warranty period, these will be made, subject to complete review by our Quality Control and Engineering Department, to determine the portion of cost to be apportioned between Customer and Magtrol, Inc., dependent on our evaluation of faulty design or workmanship claims.